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Stress Fracture and Attrition in Basic Underwater Demolition SEAL Trainees

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ABSTRACT

The Basic Underwater Demolition SEAL (BUD/S) training program is a six-month rigorous program that prepares trainees for specialized instruction before being assigned to a SEAL team. Two major but separate issues affect this program: stress fractures and attrition. Stress fracture rates are around 5-9% and may lead to attrition or training delays. Ultimately, only about 25% of trainees complete the program. The purpose of this study was to examine both stress fractures and attrition outcomes among BUD/S trainees by evaluating a combination of administrative records and self-reported health behavior data. **Methods:** The study was conducted at the Naval Special Warfare Center (NAVSPECWARCEN) BUD/S training program in Coronado, California, between April 2002 and November 2003 (classes 241 to 249). The trainees (n = 1046) were followed from the start of training to graduation (at least six months) or attrition. A 33-item health habits questionnaire was administered to the trainees upon entry. Other data sources included BUD/S training records, the NAVSPECWARCEN Command Information Management System, the Naval Medical Center San Diego medical and radiological database, and the Career History Archival Medical and Personnel System. **Results:** During the training period, 72 men (6.9%) incurred at least one stress fracture or stress reaction. Men reporting shin pain “most or all of the time” (potentially indicating recent or existing injury) on the baseline questionnaire had three times the risk of developing a stress fracture during training, even after controlling for low body mass index (BMI). Running pace, frequency, and age were not associated with stress fractures. For attrition outcomes, only 26% of the trainees graduated and half of those men took more than 263 days to finish the program. Successful graduates were more likely to have high BMI, high education, officer rank, and the modifiable factors were self-reported measures of fitness, intensity of workouts, ability to do more than 10 pull-ups, and never smoking tobacco. Not all factors were equally associated with on-time graduation, delayed graduation, and overall graduation. Many of the self-reported behaviors were associated with overall graduation, but only the ability to do more than 10 pull-ups was associated with on-time graduation. Stress fracture occurrence was associated with delayed graduation, but not with overall graduation. **Discussion:** Very few of the expected risk factors were found for stress fractures in this population. The attrition analyses found differences in risk factors between those who graduated on time, late, and not at all. **Conclusions:** Future studies should analyze training days of exposure to further explore the timing and risk factors for stress fractures. However, a better understanding of stress fractures, though valuable in itself, will not necessarily clarify attrition. The large number of voluntary drops contributed substantially to a low graduation rate and should be the focus of future studies.

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INTRODUCTION

Stress fractures are a significant problem in basic military training programs.^{1,2} Even though the rates of stress fracture have diminished dramatically in Navy and Marine Corps recruit training by applying physical training modifications, stress fracture incidence in Basic Underwater Demolition SEAL (BUD/S) trainees remains unchanged.³ According to BUD/S injury databases, as many as 40% will be diagnosed with overuse injuries during their 6-month training program and as many as 16% of trainees attrite due to stress fractures.⁴ This stress fracture rate is 9-times higher than Navy recruits and 3.5-times higher than Marine Corps recruit training populations.⁵ The numbers of BUD/S trainees requiring training delays or who are medically dropped from the SEAL basic qualification pipeline secondary to stress fractures is not trivial. However, attrition due to medical drops represents only a small portion of the approximately 75% of trainees who do not finish BUD/S training. The present study examines the role of various pretraining health behaviors and physical exercise habits on risk of stress fracture and attrition during BUD/S training.

Methods

Participants

The study was conducted at the Naval Special Warfare Center (NAVSPECWARCEN) BUD/S training program in Coronado, California. The trainees were followed from the start of training (INDOC; indoctrination weeks 1 to 5) to graduation (at least six-months) or attrition. All incoming BUD/S trainees who entered between April 2002 and November 2003 (classes 241 through 249) were recruited for the study (n = 1330). Potential participants were briefed on the study by Naval Health Research Center staff. Volunteers reviewed and signed the consent document, and they received the privacy act statement and a copy of consent form according to the guidelines of the approving Institutional Review Board (protocol number NHRC.2003.0007). BUD/S training staff members were not present during the recruitment or consenting process. A total of 1064 trainees agreed to participate in the study (80% participation rate). For the purpose of this analysis, 18 foreign BUD/S trainees were excluded due to differing BUD/S training protocols and standards, resulting in a study sample size of 1046 trainees. During the first medical visit of BUD/S INDOC training, consenting participants were administered a 33-item health history question-

naire. BUD/S enlisted medical staff assisted in administering the questionnaire.

Data Collection

Several sources were utilized to collect descriptive, exposure, and outcome data for the trainees: BUD/S training records, the NAVSPECWARCEN Command Information Management System (CIMS), the Naval Medical Center San Diego (NMCS D) medical and radiological database, the Career History Archival Medical and Personnel System (CHAMPS),⁶ and the 33-item health habit questionnaire administered to the trainees upon entry into training. From the CHAMPS database, which contains career event and medical information for military personnel, data were collected on race/ethnicity, education, months of military service, and scores on the Armed Forces Qualification Test (AFQT). From the CIMS training records, information was collected including the trainee's naval rank status (enlisted, officer, or allied), recruiting source (schools or fleet), and physical fitness scores.

Outcome Variables

Stress fracture data: BUD/S participants were assessed throughout their training program for occurrence of lower extremity musculoskeletal injuries, with specific attention to stress fractures and stress reactions. All musculoskeletal injuries were evaluated on site at the branch medical clinic (BMC) by a corpsman, physician's assistant, or physician. All suspected stress fractures were referred by the BMC licensed medical staff to the radiology department at the nearby Naval Medical Center San Diego (NMCS D) for confirmation by x-ray, triple phase bone scan, or magnetic resonance imaging (MRI) scan. The NMCS D senior staff radiologist confirmed all stress fractures. Stress fracture was defined as one or more partial or complete hairline fractures usually due to chronic pounding on nondiseased bone at any lower limb site, and a stress reaction is an impending stress fracture that does not involve disruption of the structure of the bone and does not meet the definition of a stress fracture. For this study, stress fractures and stress reactions were grouped together into a single stress fracture category. Identifiers for all 1046 enrolled subjects were entered into the NMCS D database (Composite Health Care System II) looking for the presence of a radiology report. Radiology records for study subjects were electronically extracted from the hospital database and reviewed for medically confirmed stress fracture or

reaction diagnoses at the completion of training or time of separation.

The diagnosis of a stress fracture is complicated by (a) the lack of consensus in clinical medicine about the diagnostic criteria for stress fractures, (b) the use of several clinical terms interchangeably to describe the condition (e.g., stress reaction, fatigue fracture, and pathologic fracture), (c) the use of radiographs to rule out frank fractures may not always confirm a stress fracture, and (d) the progression of stress fractures in stages, with diagnostic criteria often including a history of localized pain of insidious onset, which worsens with progressive activity and is relieved by rest.⁷ The BUD/S medical staff is trained to identify potential stress fractures early and reduce the impact on attrition. The BUD/S medical staff amelioration strategy is to treat diagnosed stress reactions before they develop into a stress fracture. Doing so can decrease the number of diagnosed stress fractures and result in fewer days out of training. The general consensus among the BUD/S medical staff is that the stress reactions would probably have developed into a stress fracture had this secondary prevention strategy not been used. For this reason the investigators pooled stress reaction and stress fracture into a single injury category.

Graduation and attrition data: BUD/S training records (CIMS) were used to provide detailed chronological information on program status of the BUD/S trainees. The data extracted from the training records included event (graduation or attrition), date of event, and type of attrition (voluntary drop out of training on request (DOR), performance drop, medical drop, or administrative drop). Two categories of graduation were created: those who graduated within 263 days of training (on time graduation) and those graduated after 263 days of training (delayed graduation).

Exposure Variables

The sources of data to obtain the demographic and personal characteristics of the trainees are as follows: age (survey), race/ethnicity, education and AFQT scores (CHAMPS), rank, months of service, and recruiting source (CIMS training record). The NAVSPECWARCEN medical staff measured height and weight during INDOC. Body mass index (BMI) was calculated as weight (in kilograms) divided by the square of height (in meters). For analysis, BMI was used as a continuous variable.

All incoming BUD/S trainees are required to complete a Physical Fitness Test (PFT) to assess

minimal physical fitness. The PFT is administered during INDOC to ensure that incoming trainees meet the minimum standards for advancement to regular training. During the data collection period of the study, a BUD/S training program procedural change was implemented such that the documentation of PFT scores was changed to specify pass or fail rather than recording the actual time or number. This change resulted in 412 (39%) trainees without actual times or numbers for PFT performance tests, so this measure could not be used in the analysis.

Using information collected from the study questionnaire, current physical fitness level was self-assessed as poor, fair, good, very good, and excellent. For analysis, this variable was dichotomized into two categories: “excellent/very good fitness” and “poor/fair/good fitness.” The questionnaire also collected information on those who reported that they “worked up a good sweat” most or all of the time when they exercised and those who reported that they could do more than 10 pull-ups.

In addition, trainees were asked several questions about their exercise habits during the 2 to 3 months prior to attending BUD/S training. These questions included information on whether the trainee increased his level of exercise or sport, exercised or played sports at least four times a week, and ran or jogged at least four times a week. For those who reported running or jogging at least four times a week, the average running pace (minutes per mile) was calculated from average distance run and time of average run, and they were asked to report how much they enjoyed running. Trainees were also asked if they participated in any lower and upper body stretching and lower and upper body weight training. These two variables were combined for analysis (doing either lower body stretching or weight training at least two times per week).

The questionnaire also assessed self-reported use of smoking tobacco and alcohol (e.g., beer, wine, and/or liquor/mixed drinks). Responses for smoking tobacco use included “never smoked tobacco,” “former smoker” (having not smoked in the past year), and “current smoker.” Because of the small number of current smokers, two categories were created: “never smoked” and “ever smoked” (which included past smokers and current smokers). For alcohol use, the responses to various questions on consumption were combined to make two categories of “never used any type of alcohol” and “ever used any type of alcohol.”

Previous lower body musculoskeletal injuries were defined as any injury of the bone, muscle, tendon,

ligament, and/or cartilage that occurred in the lower limbs. Using the study questionnaire, trainees who reported any lower body musculoskeletal injuries prior to BUD/S training provided additional answers to questions, such as “Did the injury result in disability for at least one week” and, “Following the injury, were you able to return 100% to normal physical activity?” and “Did a health care provider ever tell you that you have a stress fracture in one or both of your lower limbs?” Finally, all trainees were asked to report if they were currently experiencing shin pain during or following physical activity in either their right or left shin (most/all the time).

Statistical Analyses

SPSS statistical software (SPSS, Inc., Chicago, IL, version 11.0) was used to analyze the data. Descriptive statistics were used to characterize participating trainees. Descriptive data included means and standard deviations or percentages. Means and standard deviations for continuous variables, such as age, height, weight, BMI, and running pace, were calculated by stress fracture and graduation status. Univariate logistic models were used to identify statistically significant differences between stress fracture status and each of the demographic and health behavior variables. Multivariable logistic regression models were developed to assess the combined effect of statistically significant variables while controlling for possible confounding variables. Odds ratios were calculated. An odds ratio helps illustrate whether members of specific groups have an increased likelihood (or odds) for developing the outcome of interest based on their exposure characteristics. An odds ratio of 1.0 means there is no association between exposure group and the outcome of interest. In all cases, statistical significance was determined by 95% confidence intervals that did not include 1.0. For the attrition data, logistic regression and polychotomous logistic regression techniques were used to assess the relationship of graduating versus not graduating, as well as comparing graduating on time and delayed graduation versus attrition for each of the demographic and health behavior variables.

RESULTS

Injury Outcomes

During the BUD/S training, a total of 96 bone injuries (50 stress reactions, 36 stress fractures, and 10 frank fractures) occurred in 80 (7.6%) of the 1046 trainees; some had more than one injury. Seventy-two (6.9%) of the 1046 trainees incurred at least one stress

fracture or stress reaction; 51 men (4.9%) incurred a stress reaction and 45 men (4.3%) incurred a stress fracture.

The average age of the trainees was 23 years and did not vary by stress fracture status. Overall mean BMI was 24.9 with a standard deviation of 2.1. Men with a stress fracture during training had a lower baseline BMI than those without ($p < 0.05$). The majority of the trainees were Caucasian, non-Hispanic (80%), followed by Hispanic (9%), Asian/Pacific Islanders/Native Americans (6%), and African American, non-Hispanic (4%). Stress fracture risk did not vary by racial/ethnic group. Approximately 81% of the trainees had earned a high school diploma/GED, and 18% had completed some college course work or earned a 2- or 4-year college degree. The majority of the trainees (94%) were enlisted rank and the remaining 6% were U.S. Navy officers. More than half of the trainees had been in the service less than 9 months. About two thirds of the trainees came from the fleet, and the most common AFQT category was Category II (65th to 92nd percentile) representing more than half the trainees. None of these variables were associated with stress fractures. While physical fitness scores were available for only 61% (634) of the sample and could not be included in the modeling, none of the differences in swimming, push-ups, sit-ups, pull-ups, or running time were statistically different between those with and without a stress fracture.

In general, the trainees reported fairly good health behaviors: 55% reported very good or excellent physical fitness compared with others their age, and 39% reported working up a sweat most or all of the time during exercise. Eighty-four percent reported that they could do more than 10 pull-ups. Over 90% of the trainees reported exercising four or more times a week, and almost 70% reported running four or more times per week during the two to three months prior to BUD/S training. More than half of the trainees (54%) reported increasing their exercise level during the months prior to training. In addition to running, just over half of the trainees reported lower body weight training or stretching at least two times per week. Twenty-two percent of the trainees reported ever smoking cigarettes while most trainees (80%) report ever using alcohol. However, none of the self-reported health behaviors were associated with stress fractures.

Current shin pain was the only variable associated with stress fracture; trainees reporting shin pain at baseline had about three times the risk of

stress fracture compared with those without shin pain (13% of those with stress fracture reported shin pain most or all of the time compared with only 5% of those without stress fracture). The other injury variables (previous lower body injury, severity and recuperation from previous injury, or previous stress fracture) did not vary by stress fracture status. The statistically significant variables in the univariate analyses (BMI and current shin pain) were used to build a logistic model for stress fracture. The results, shown in Table 1, show that presence of shin pain and BMI (lighter men) are both independently related to the occurrence of stress fracture during BUD/S training.

TABLE I: MULTIVARIATE LOGISTIC REGRESSION OF U.S. NAVY BUD/S TRAINEES BY STRESS FRACTURE STATUS, N = 1046

<i>Characteristic</i>	<i>OR*</i>	<i>95% CI*</i>
<i>Physical/personal</i>		
BMI**	0.9	(0.8, 0.9)
<i>Injury history</i>		
Currently feels shin pain a lot/most of the time		
No	1.0	
Yes	2.9	(1.4, 6.3)

* Odds ratio and 95% confidence interval for the odds ratio. An odds ratio of 1.0 signifies no association between the characteristics and stress fracture. An odds ratio of over 1.0 indicates a higher risk while an odds ratio below 1.0 indicates a lower risk. If the 95% confidence interval does not include 1.0 then the odds ratio is meaningful.

** BMI-Body mass index (weight (kg)/height (m)²).

Bolded figures indicate statistical significance.

Attrition Outcomes

Overall, 274 (26%) of the trainees in our study sample graduated from the BUD/S training program. About half of the trainees graduated on time (defined as within 263 days), with the remainder graduating at some later point. Among the 772 men (74%) who did not complete the BUD/S training program, 83% DOR, 10% dropped for medical reasons, 6% dropped for performance issues, 1% dropped for administrative (discipline) issues, and two men 0.2% were aboard at the time of analysis (560 days, 637 days). For analysis purposes of this study, the two aboard trainees were designated as men who did not complete the BUD/S training program (Table 2).

TABLE II: GRADUATION STATUS OF U.S. NAVY BUD/S TRAINEES, N = 1046

<i>Graduation Status</i>	<i>n</i>	<i>%</i>
Graduated	274	26.2
On time (within 263 days)	138	50.4
Delayed (beyond 263 days)	136	49.6
Did not graduate	772	73.8
Dropped on request (DOR)	642	83.2
Medical drop	75	9.7
Performance drop	43	5.6
Administrative drop	10	1.3
Aboard*	2	0.2

* Indicates subjects who had not completed BUD/S training as of 6/16/05.

Overall, men with high BMI, at least some college, officer rank, and who reported that they had excellent/very good physical fitness, worked up a sweat most of the time during exercise, could do more than 10 pull-ups, exercised four or more times per week, ran or jogged four or more times per week and never smoked tobacco were more likely to graduate from BUD/S training. Among those who ran or jogged four or more times per week, a fast running pace, and enjoying running were both associated with overall graduation.

When separately analyzing those who graduated on time and those who had delayed graduation (in both cases compared with those who did not graduate at all), the relationship for high BMI, education, and rank remained important predictors of graduating on time. Although stress fracture occurrence during training was not related to overall graduation, it was related to delayed graduation.

All of the statistically significant variables found in the univariate descriptive characteristics were simultaneously used to build a logistic model to predict overall graduation status. A second multivariable model compared those who did not graduate with those who graduated on time and those who graduated late (delayed graduation). The results, shown in Figure 1, adjusted for age, BMI, race/ethnicity, education, and rank, indicate that high levels of self-assessed fitness, working up a sweat during exercise most or all of the time, able to do more than 10 pull-ups, and never using cigarettes were all independently associated with overall graduation from BUD/S training; note that having a stress fracture during

training was not associated with overall graduation. After adjusting for age, BMI, race/ethnicity, education, and rank, only two variables were associated with graduating on time: not having a stress fracture during training and the self-reported ability to do 10 pull-ups prior to training. After adjustment, the factors associated with delayed graduation included having a stress fracture during training, reporting high levels of fitness, and working up a sweat during exercise prior to training. Occurrence of a stress fracture during training was associated with lower rates of graduating on time and higher rates of delayed graduation, but not with the overall graduation rate.

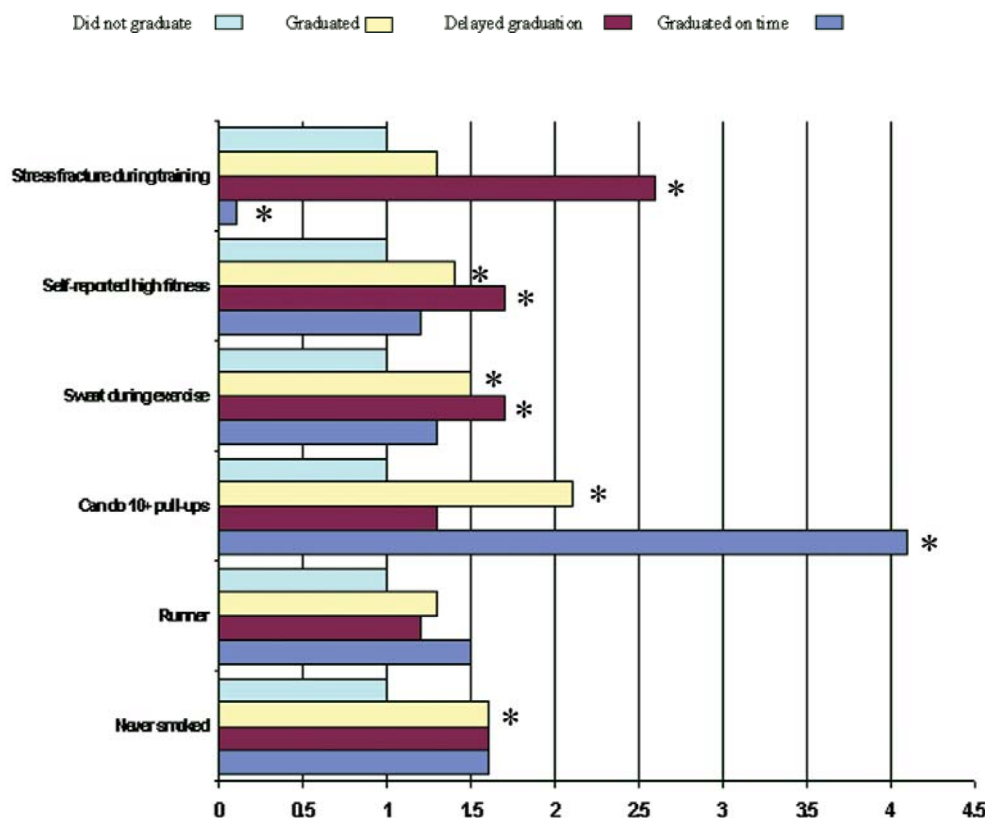
Fig. 1. Multiple logistic regression model for selected characteristics by graduation status.

Odds ratios (X-axis) are adjusted for age, BMI, race/ethnicity, education, and rank plus all other characteristics shown in the figure.

An odds ratio of 1.0 signifies no association between the characteristic and graduation category. An odds ratio of over 1.0 indicates a higher risk while an odds ratio below 1.0 indicates a lower risk.

All measures are self-reported except “stress fracture during training”

* Statistically significant differences from those who did not graduate (the reference group).



DISCUSSION

The U.S. Special Operations Command (USSOCOM), Biomedical Initiatives Steering Committee (BISC) commissioned this study to report the magnitude of the stress fracture problem during BUD/S training and identify factors related to attrition with special attention to stress fractures.

Stress Fracture

During the BUD/S training program, 72 of the 1046 trainees (6.9 %) incurred at least one stress fracture or stress reaction. This is slightly lower than reported in other studies of BUD/S trainees.³ The study sample size (n = 1046) was larger than any prospective study found in the medical scientific literature for U.S. Special Operations Forces personnel and one of the strengths of the present study is that the follow-up of stress fracture was confirmed using a strict protocol.⁷ Stress fracture definition in the scientific literature is inconsistent, so it is difficult to compare other studies without verifying diagnostic criteria.^{7,8} However, in the present study, inconclusive plain radiographs were usually followed up with a technetium bone scan or MRI to confirm diagnoses. Any positive radiographic test without clinical symptoms

could represent a prevalent injury and were not defined as an incident stress fracture, and because radiographic diagnoses are subject to errors, primarily false negative,⁹ they were not included as a stress fracture case. In this investigation, radiologists at NMCS D performed the diagnostic reading and did not rely on routine orthopedic consultation. The literature shows no evidence of significant misinterpretations in the reading comparing these two medical specialties,¹⁰ and the decision for consultation is set by institutional policy and usually is focused on health care cost savings.¹¹

The only variables that identify trainees

at risk for stress fracture during training are entry-level low BMI and current shin pain. It is not known if their current shin pain was a stress reaction and, therefore, a precursor for stress fracture. It usually takes two to three weeks of unaccustomed activity to cause a stress fracture, and current symptoms of shin pain could mean periosteal or endosteal reaction already occurring prior to the start of INDOC.⁷ Eliminating the 54 subjects with shin pain at entry, the numerator would decrease from 72 to 60 (subtracting 12 who had a stress fracture) and the denominator would go from 1046 to 992 (subtracting 54) for an adjusted stress fracture incidence of 6.1%. Eleven (20.4%) of the 54 trainees who reported experiencing shin pain a lot or most of the time after exercising were among the graduates, slightly lower than the overall 26% graduation rate. It is important to note that had NAVSPECWARCEN eliminated the 54 trainees with shin pain at the beginning of training, they would have eliminated 11 BUD/S graduates – 11 potential SEALs.

Attrition

Two categories of graduation were created: those who graduated within 263 days of training (on time graduation) and those graduated after 263 days of training (delayed graduation). BUD/S trainees typically report to NAVSPECWARCEN for forming (muster) up to eight weeks before official training. Trainees undergo entry-level physical training during forming and INDOC, a five-week indoctrination program mandated by the Chief of Naval Education and Training (CNET). Formal BUD/S training is divided into three distinct phases of eight to nine weeks duration: First Phase includes the notorious “Hell Week”; Second Phase is described as Open Circuit and Closed Circuit training; Third Phase occurs mostly off-site NAVSPECWARCEN and involves land warfare, reconnaissance, shooting, and specialized training. In summary, the total time on board including forming and INDOC is approximately 263 days.

Only 26% of U.S. Navy BUD/S trainees in classes 241 to 249 graduated from the training program. Most of the group who did not graduate (83%) dropped the program voluntarily. Several factors were identified that were associated with successful completion of the program. The factors included high BMI, having at least some college (compared with high school graduates), self-reporting excellent or very good fitness, working up a sweat most or all of the time during exercise, being able to do 10 pull-

ups, and never using tobacco. All of these variables were collected prior to the training program and could be useful as part of the picture in assessing which trainees might succeed in the program. Most of these variables are self-reported and generally describe personal health traits that suggest a strong motivation to be active and healthy.

The most interesting finding for attrition is the differences between those who graduate on time, graduate late, and do not graduate at all. For example, our results suggest that successful trainees who go through the program without setbacks are different from those who do not graduate in that they do not incur a stress fracture during training and they enter training with the ability to do at least 10 pull-ups. However, those who graduate late (after 263 days) are more likely to have incurred a stress fracture and report high fitness levels and exercise levels, but (as a group) are not different than those who do not graduate in their stated ability to do at least 10 pull-ups. As expected, stress fractures during training are strongly associated with delayed graduation; however, they are not associated with overall graduation rates, and represent only a minor portion of those who attrite. The trainee who ultimately graduates may have been exercising hard to get into shape and thus may have increased his risk for a stress fracture. However, even controlling for stress fracture occurrence, the inability to do at least 10 pull-ups may be a marker for some other physical condition that may delay graduation.

Limitations

During the data collection period, a BUD/S training program procedural change was implemented: the documentation of PFT scores was changed to specify pass or fail rather than recording the actual time or number, so this measure could not be used in the analysis. We would have preferred to collect the swim and run times, and number of sit-ups, pull-ups, and push-ups, and analyze continuous data rather than a dichotomous pass or fail, because interpreting continuous data can help establish changes in physical test cut-points.

The BUD/S medical staff is trained to identify potential stress fractures early and reduce the impact on attrition. Their amelioration strategy is to treat diagnosed stress reactions before they develop into a stress fracture. Doing so can decrease the number of diagnosed stress fractures and result in fewer days out of training. The general consensus

among the BUD/S medical staff is that a stress reaction would probably have developed into a stress fracture had this secondary prevention strategy not been used. For this reason the investigators pooled stress reaction and stress fracture into a single injury category. This comment is only a limitation when comparing rates from previous studies; otherwise, it should be considered a strength of medical care. The BUD/S medical staff has tuned in to the signs and symptoms of stress fractures and treats all stress reactions immediately, before radiological confirmation, as if they are diagnosed as a stress fracture.

Directions for Future Studies

Future research could analyze training day exposures as a way to explore the timing of these injuries and facilitate comparison within and between military and civilian populations. Person-time injury incidence rates, such as the rate of injury per 100 person-months of exposure, allow for comparison between study populations who have different exposure times at risk. In contrast, cumulative incidence of musculoskeletal injuries in military populations have been reported extensively in the literature, however, these studies are difficult to compare within and between populations because they have used varied definitions to determine injuries and population at risk. Another manuscript using the data from this study could present person-time injury incidence rates and compare them with other military populations^{1,4,12,13} to gather further insight into the magnitude of the stress fracture problem during BUD/S training. It might reveal that taking into account the duration of BUD/S training, their person-time stress fracture rate is equal to or less than that of the other services.

CONCLUSIONS

This study found that shin pain and low BMI are both risk factors for stress fracture during BUD/S training, suggesting that attention to shin pain and body weight issues prior to the start of training could be important in reducing the number of stress fractures. Evaluating person-time incidence rates and the timing (the week in training) of the stress fracture occurrence could also provide insight as to when in the program these are most likely to occur; prevention and intervention strategies should follow evidence-based results.

Having good exercise behaviors prior to training, especially the ability to do 10 or more pull-ups,

may be the best indicators for completing the BUD/S training. Although many self-report exercise and health habits were related to graduation, attrition is complicated by the long program and lack of specific information on the reasons for voluntary drops. Collecting standardized information at exit may lead to better understanding of the process involved in attrition.

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Adriana Villaseñor, MPH, is a research associate at the Naval Health Research Center currently developing a peer support program for USMC troops in theater. She has been involved in numerous collaborative National Institutes of Health research studies primarily pertaining to behavioral intervention to reduce or prevent smoking, alter nutritional habits, improve exercise, and improve work-site wellness.

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14. ABSTRACT (maximum 200 words) <i>Purpose:</i> To examine stress fracture incidence and attrition outcomes among trainees of the Basic Underwater Demolition/SEAL (BUD/S) program. Typically, the stress fracture rate is high and only about 25% of trainees ultimately graduate. <i>Methods:</i> The study was conducted at the Naval Special Warfare Center (NAVSPECWARCEN) BUD/S training program in Coronado, California, between April 2002 and November 2003 (classes 241–249). The trainees (n = 1046) were followed from the start of training to graduation (at least 6 months) or attrition. Data were collected using a combination of medical records, administrative records, and self-reported health behavior information to examine stress fractures and attrition outcomes. <i>Results:</i> During the training period, 72 men (6.9%) incurred at least one stress fracture or stress reaction. Men reporting shin pain “most or all of the time” on the baseline questionnaire were at 3 times the risk of developing a stress fracture during training. Only 26% of the trainees graduated and half of these men took more than 263 days to finish the program. <i>Conclusions:</i> This study suggests that future studies of this program should consider analyzing training days of exposure to further explore the timing and risk factors for stress fractures. A large number of voluntary drops from training contributes substantially to a low graduation rate and should be the focus of future studies.					
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